

POSSIBILITIES OF SEASON EXTENSION OF TWO POLISH JUNE-BEARING STRAWBERRIES

Agnieszka Masny

Edward Żurawicz

Research Institute of Horticulture,
Skierniewice, Poland

SEMINAR OF WP 2

24. Sep. 2013, Trondheim - Norway



INTRODUCTION

- **Majority of the Polish strawberry production is located in the open field.**
- **Only about 10-15 % of strawberries are produced using special technologies for extending fruit ripening season.**
- **Success in such kind of the production is depended mainly on the climate conditions.**

GENERAL INFORMATION ABOUT POLISH CLIMATIC CONDITIONS

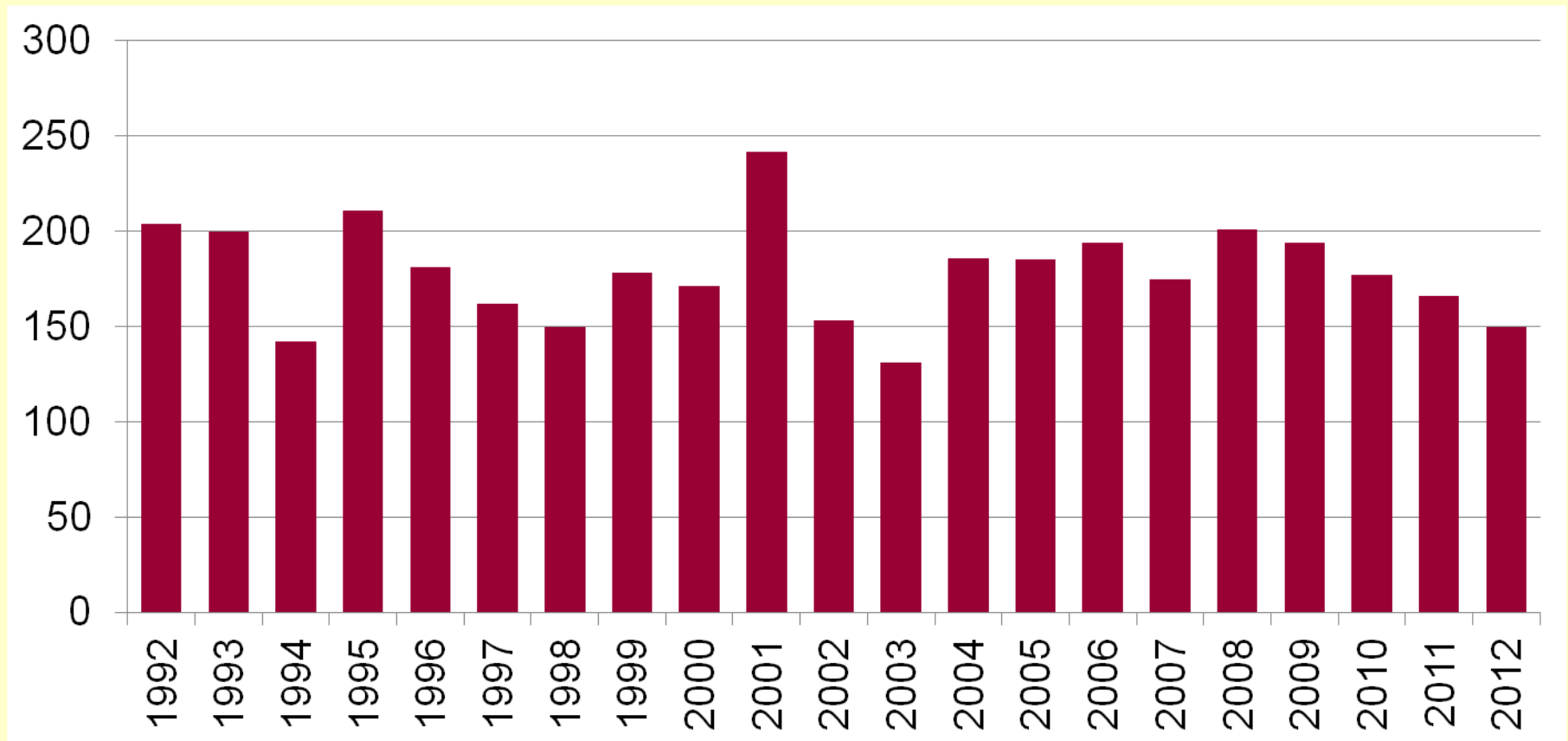
- **Very variable climate**
- **Mean yearly temperature ranges from 6,0°C to 8,5°C**
- **Average yearly precipitation is 500 - 600 mm**
- **Warmest month is July, the temp. exceeds + 30°C**
- **Coldest month is January, the temp. drops below - 30°C**

Such extreme temperatures are adverse for strawberry plants (strong damages during winter) and fruits (poor quality).

STRAWBERRY PRODUCTION IN POLAND



Thousand tonnes

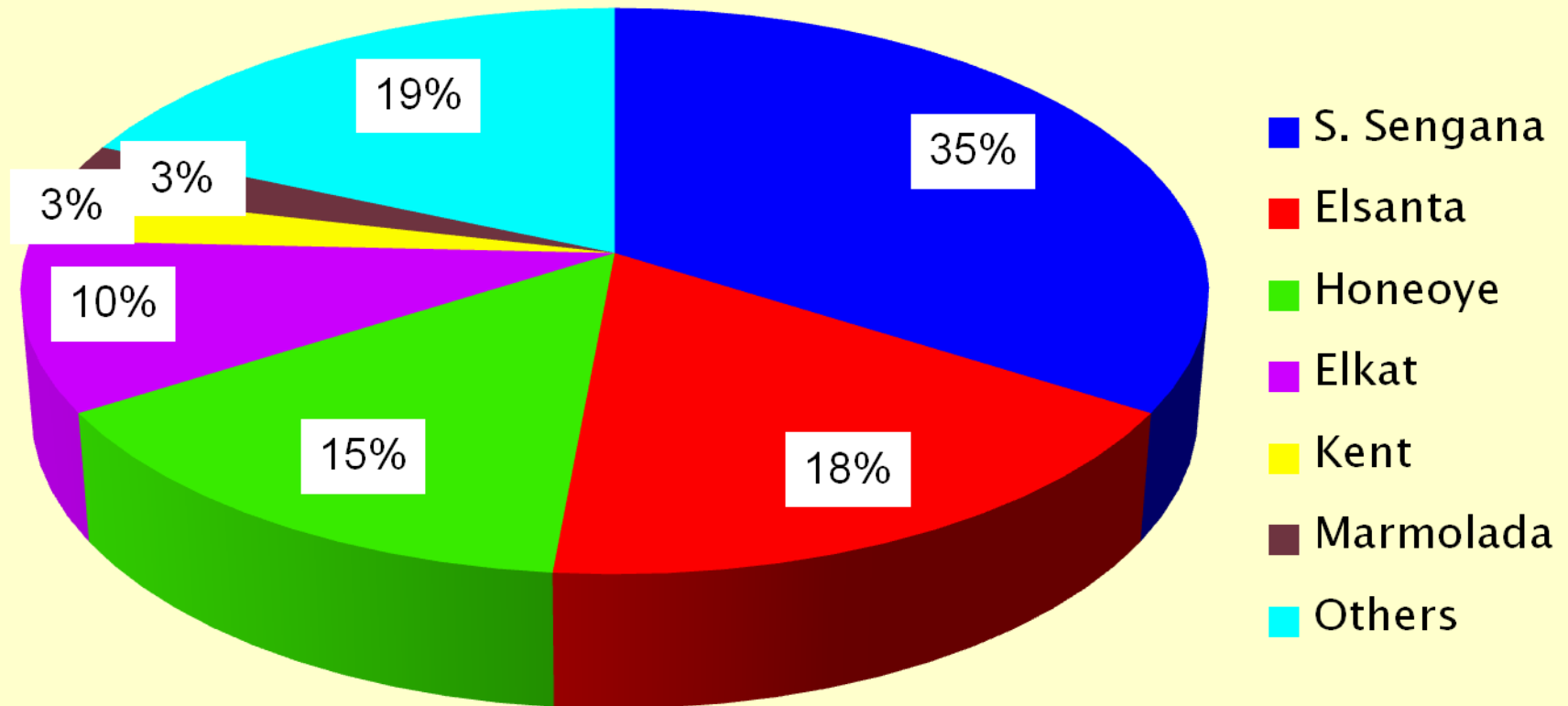


CHANGES IN POLISH STRAWBERRY PRODUCTION IN LAST TWENTY YEARS

- A continuous increase of growing cultivars for fresh market and decrease of 'Senga Sengana' for processing.
- Extending fruit ripening time by using new cultivars as well as new technologies in strawberry production in the field and under covers

STRUCTURE OF STRAWBERRY CULTIVARS

(recently grown in Poland)



STUDIES IN FRAME OF EUBerry PROJECT – WP 2:

Aimed at: development of strawberry production for extending fruit harvesting time

to obtain:

- Early ripening under high polyethylene tunnels (Exp. I)
- Late ripening under high tunnels and polyethylene roofs (Exp. II)
- Late harvest in the open field, using method of late planting of frigo plants (Exp. III)

Conducted:

- Research Institute of Horticulture, Skierniewice
- 2012-2013



GRANDAROSA

‘Granda’ x ‘Camarosa’

(submitted into the Polish National List of Fruit Plant Varieties in 2010)

-
- **Fruit ripening time:** medium early
 - **Productivity:** high
 - **Fruits:** large and very large, very regular conical shape, orange-red skin, strong glossiness, very high firmness



Susceptibility to diseases:

- Strawberry leaf spot - low
- Powdery mildew – low
- Leaf scorch – medium
- Verticillium wilt – medium
- Grey mold - low

PINK ROSA

‘Granda’ x ‘Sophie’

(submitted into the Polish National List of Fruit Plant Varieties in 2011)

- **Fruit ripening time:** late
- **Productivity:** high
- **Fruits:** very large, wide conical shape, orange-pink skin, medium strong glossiness, high firmness

Susceptibility to diseases:

- Strawberry leaf spot – low
- Powdery mildew – low
- Leaf scorch – medium
- Verticillium wilt - low
- Grey mold - low



ELSANTA

‘Gorella’ x ‘Holiday’

(released into the Polish National List of Fruit Plant Varieties in 1994)



-
- **Fruit ripening time:** medium early
 - **Productivity:** medium
 - **Fruits:** large and medium size, regular wide conical shape, bright red, strong glossiness, high firmness



Susceptibility to diseases:

- Verticillium wilt – very high
- Powdery mildew - high
- Grey mold - low
- Strawberry leaf spot and leaf scorch – resistant

EXP. I: PRODUCTION FOR EARLY FRUIT RIPENING UNDER HIGH TUNNEL (2nd harvest of plants used previously for late ripening and stored during winter)

PLANT MATERIAL

- 3 cultivars
- planted on 17th July 2012 in coco mats on gutters (Formflex)
- stored during the winter in the cold store (-2°C) or unheated high polyethylene tunnel (on the ground covered by fibre-cover)



DESIGN OF THE EXPERIMENT

- 6 plants per plot (coco mat)
- 6 replications



EXP. I: PRODUCTION FOR EARLY FRUIT RIPENING UNDER HIGH TUNNEL (2nd harvest of plants used previously for late ripening and stored during winter)

FRUIT RIPENING TIME – FAEDI INDEX



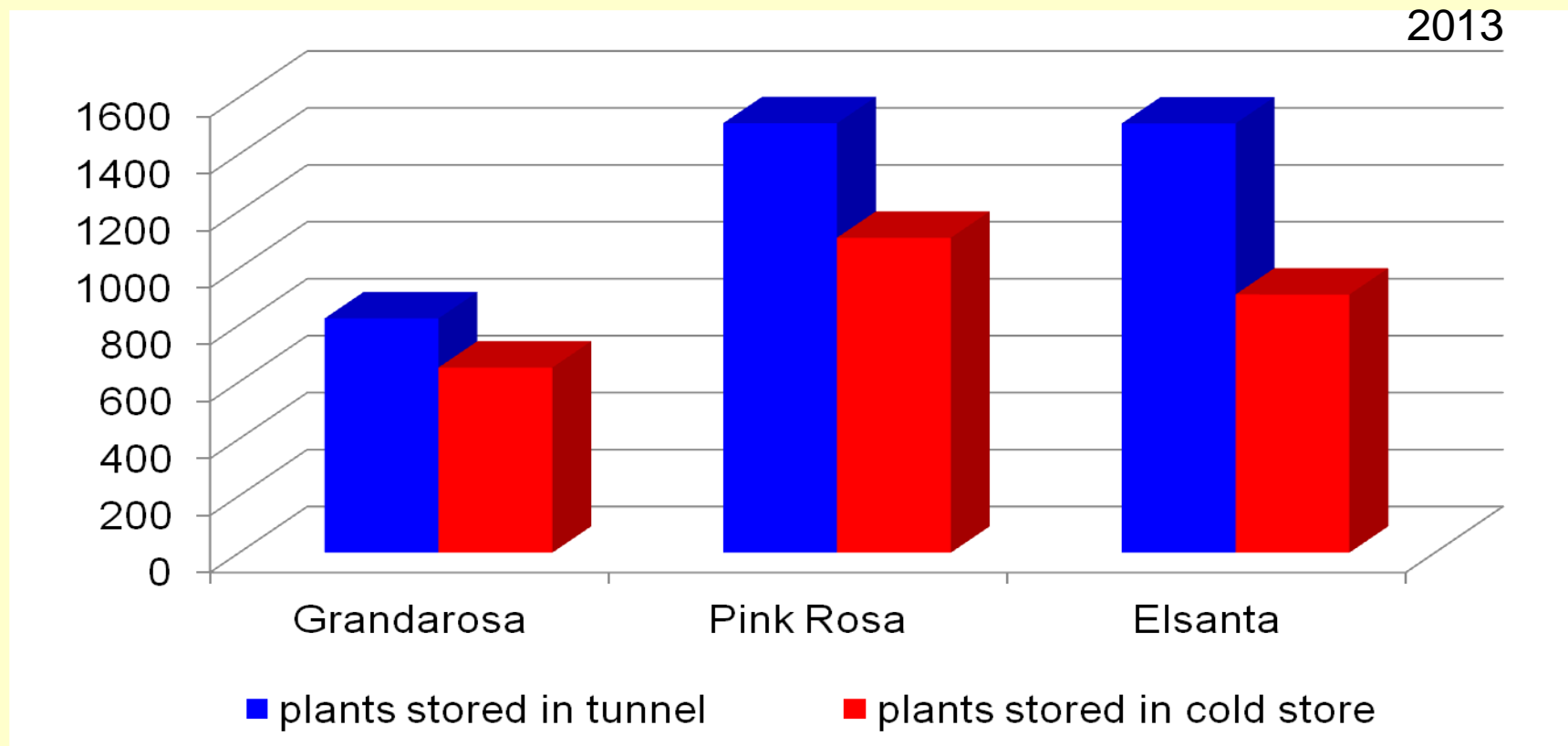
First ripened fruits – Elsanta stored in tunnel

A few days later - Grandarosa and Pink Rosa stored in tunnel

The latest fruits – Grandarosa and Pink Rosa stored in cold store

EXP. I: PRODUCTION FOR EARLY FRUIT RIPENING UNDER HIGH TUNNEL (2nd harvest of plants used previously for late ripening and stored during winter)

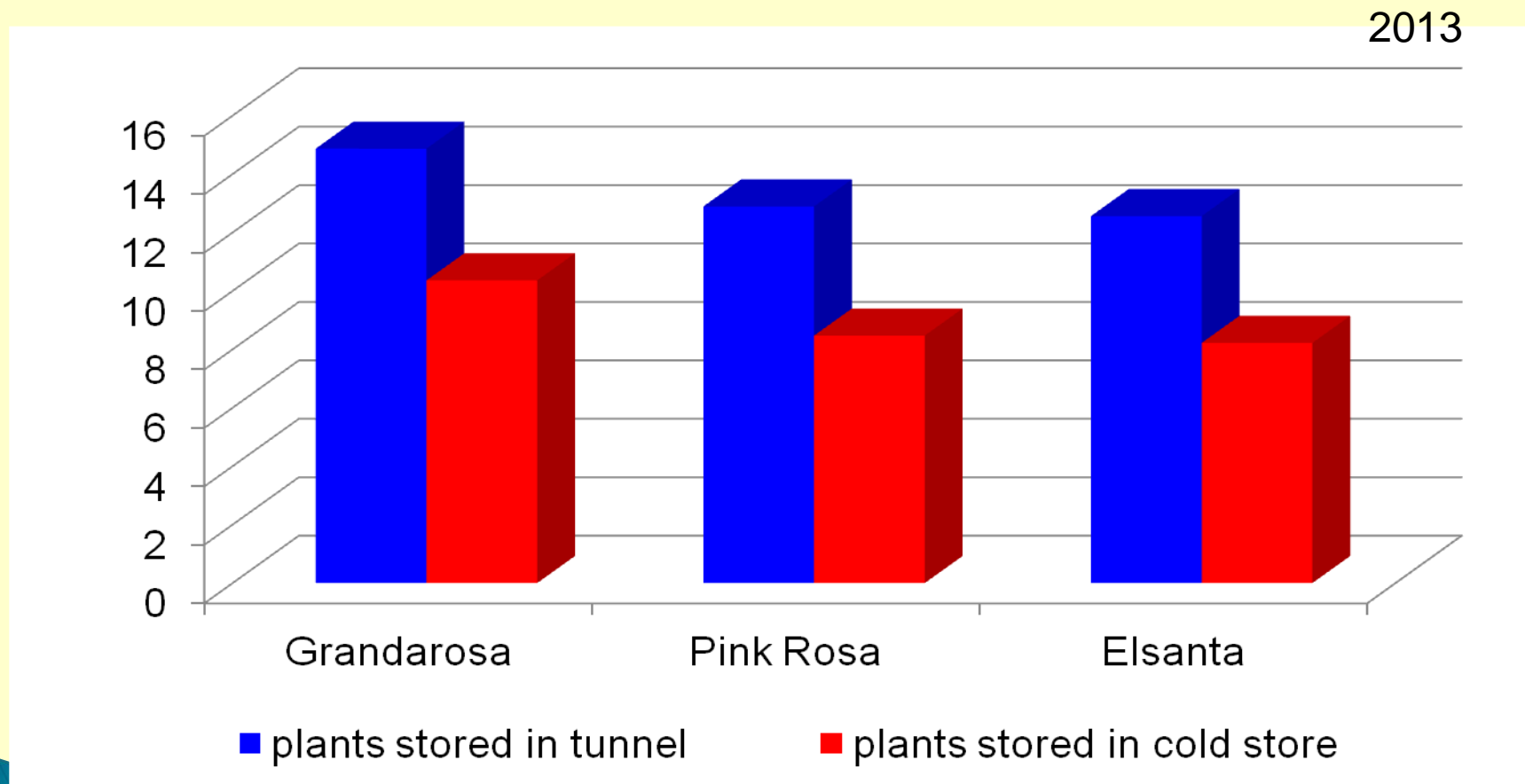
PRODUCTIVITY (g/plot – 6 plants)



Plants stored in tunnel were more productive than plants stored in cold store
The highest yield obtained from Pink Rosa and Elsanta

EXP. I: PRODUCTION FOR EARLY FRUIT RIPENING UNDER HIGH TUNNEL (2nd harvest of plants used previously for late ripening and stored during winter)

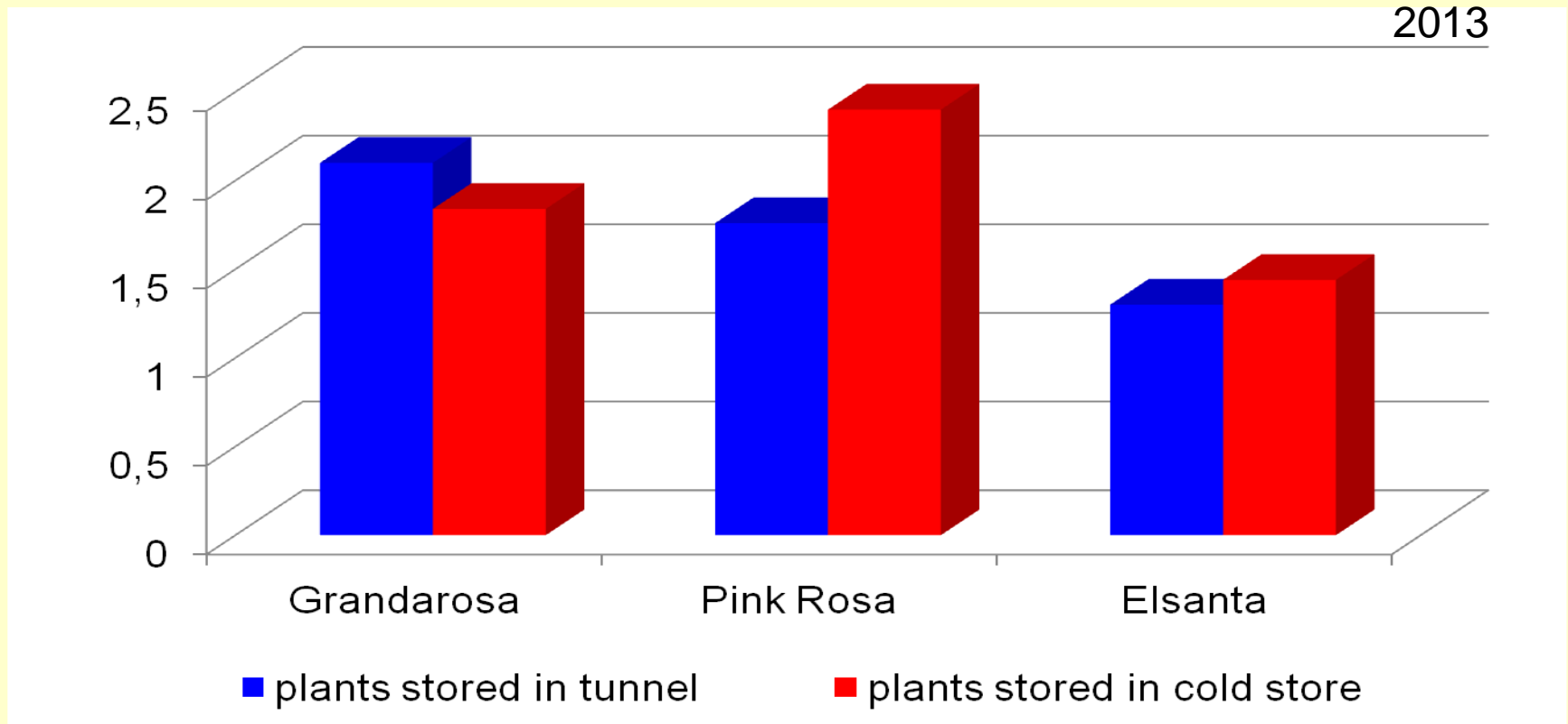
AVERAGE FRUIT WEIGHT (g)



Plants stored in tunnel produced much larger fruits than plants from cold store
The largest fruits had Grandarosa

EXP. I: PRODUCTION FOR EARLY FRUIT RIPENING UNDER HIGH TUNNEL (2nd harvest of plants used previously for late ripening and stored during winter)

FRUIT FIRMNESS (N)



Fruits from Grandarosa plants stored in tunnel were firmer than from cold store
In the case of Pink Rosa and Elsanta – fruits from plants stored in tunnel were softer than from cold store

SUMMARY – Experiment I

- Plants stored during winter under unheated polyethylene tunnel ripened earlier and were more productive than plants stored in the cold store. The earliest cultivar was Elsanta.
- The plants stored under tunnel produced also larger fruits than plants stored in the cold store. The largest fruits were obtained from Grandarosa.
- Plants stored under unheated polyethylene tunnel were characterized by similar or lower fruit firmness in comparison to the plants stored in the cold store.

EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

PLANT MATERIAL

- 3 cultivars
- planted on 17th July 2012 (Series A) and 19th July 2013 (Series B) in coco mats on gutters (Formflex)
- Potted plants (Series A)
- Potted and bare root plants (Series B)

DESIGN OF THE EXPERIMENT

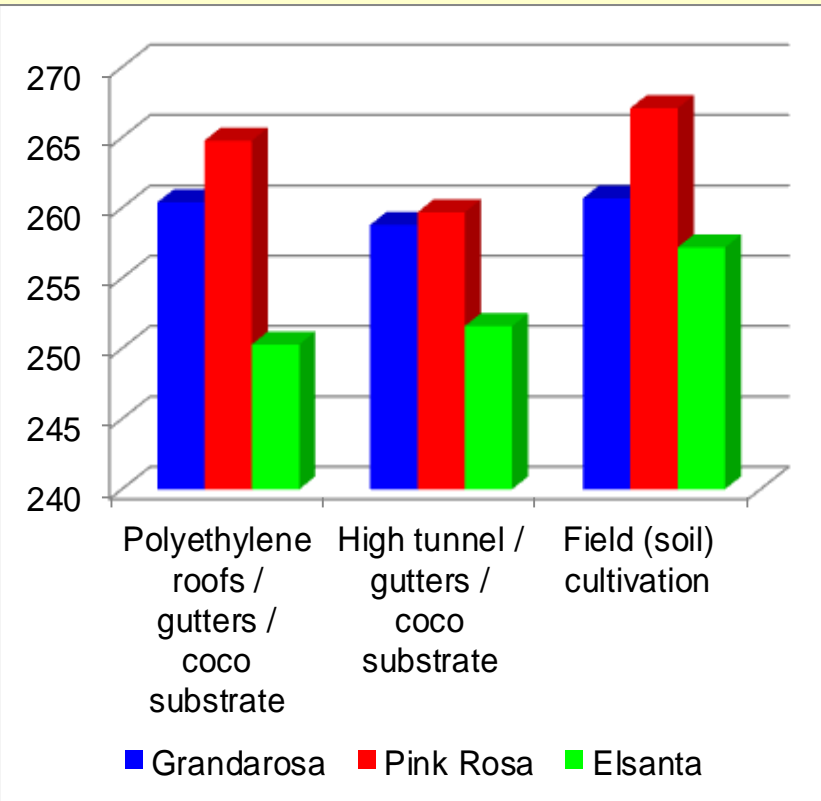
- 6 plants per plot (coco mat)
- 6 replications



EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

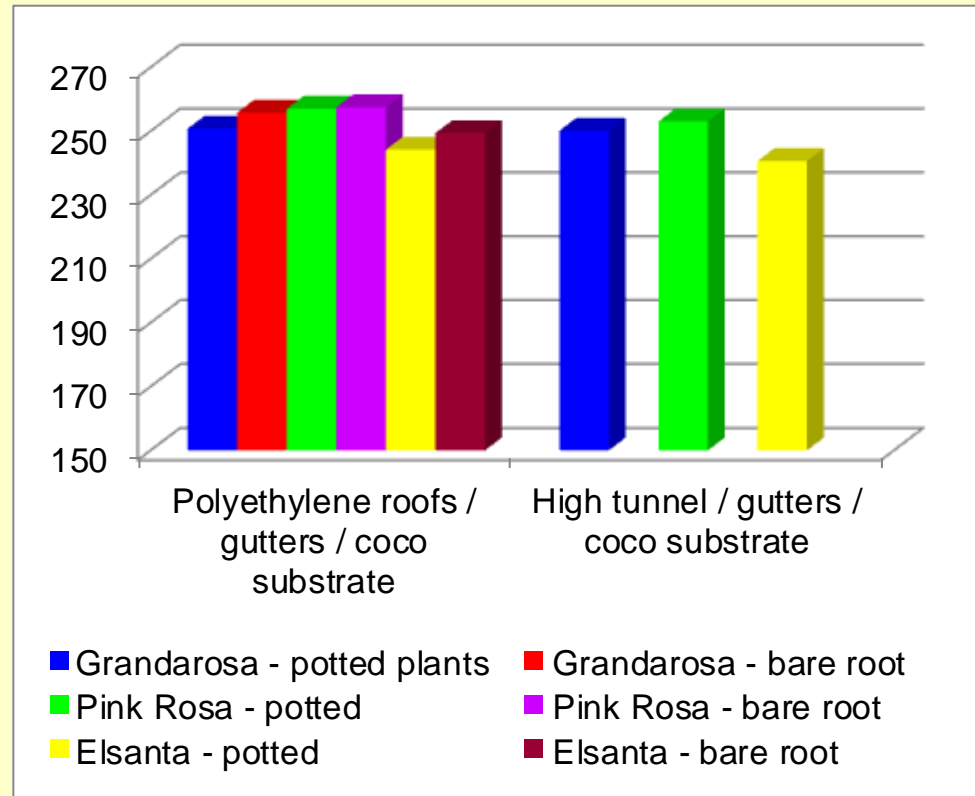
FRUIT RIPENING TIME (FAEDI INDEX)

2012



!!! Plants under polyethylene roofs are still being picked up

2013

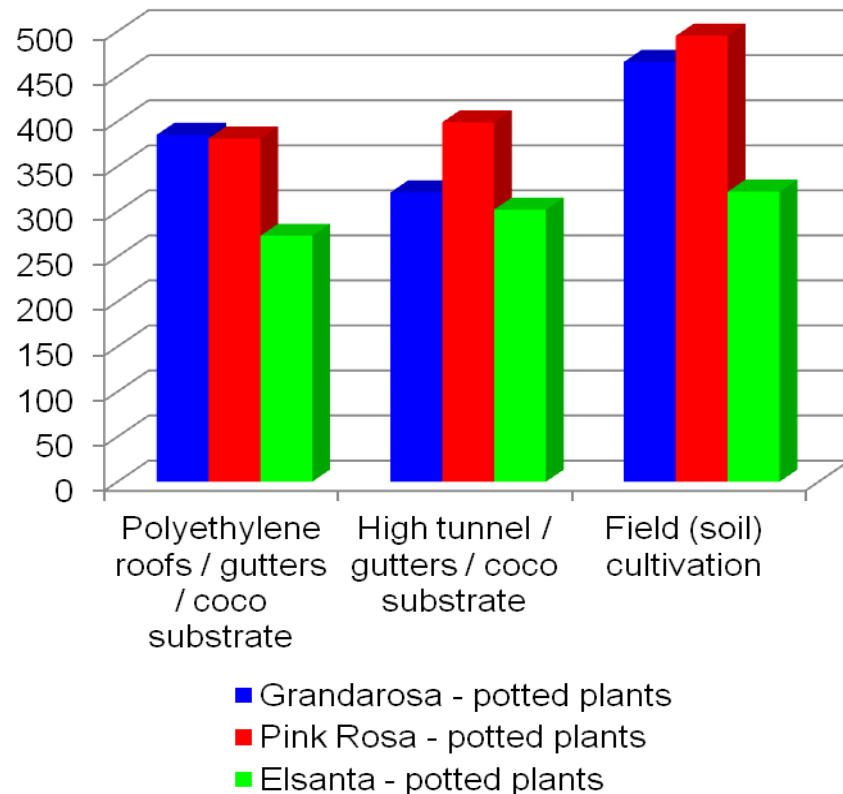


2012: First fruits – Elsanta grown under high tunnel and polyethylene roofs
 Polish cultivars – first – under tunnel, later – under roofs and in open field
 2013: First fruits – under tunnel, 3-4 days later – under roofs
 The most early – Elsanta, the most late – Pink Rosa (still at full ripening)

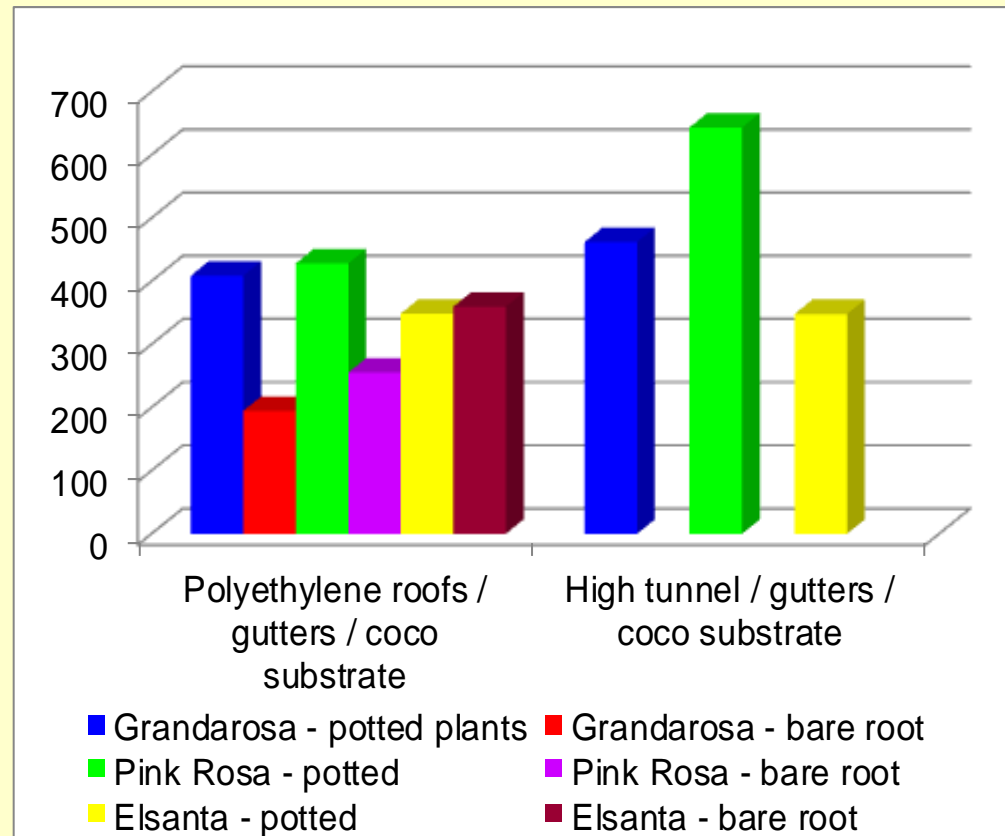
EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

PRODUCTIVITY (g/ plot – 6 plants)

2012



2013

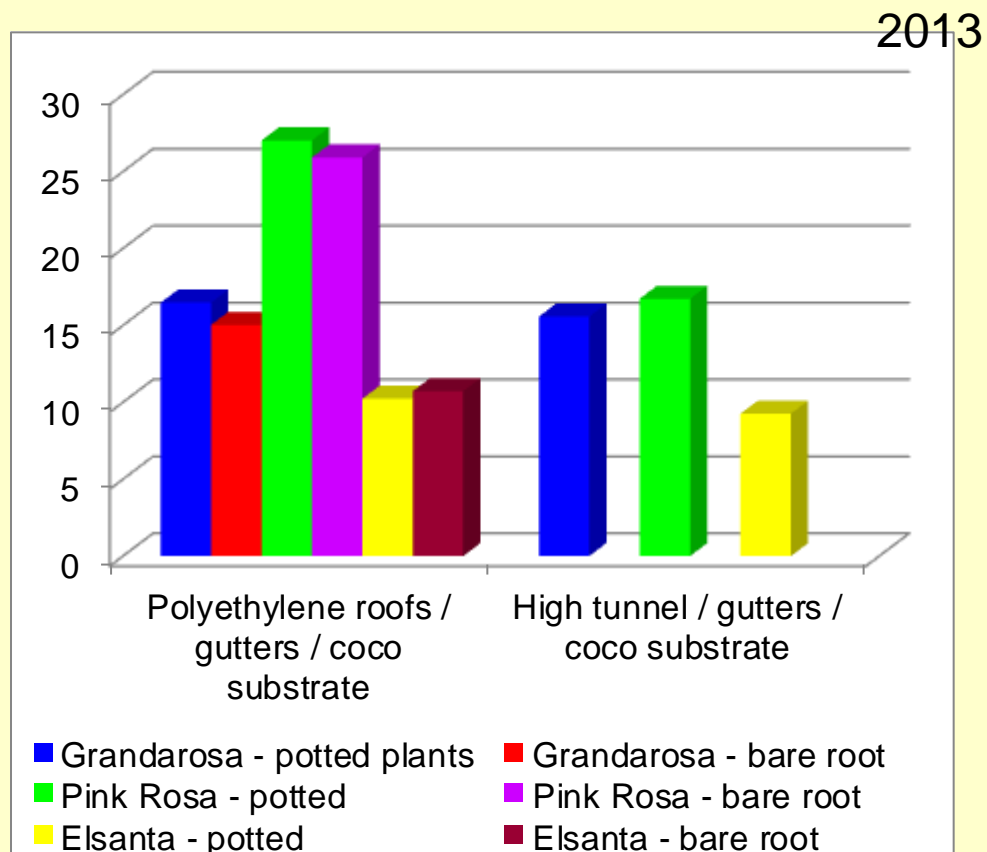
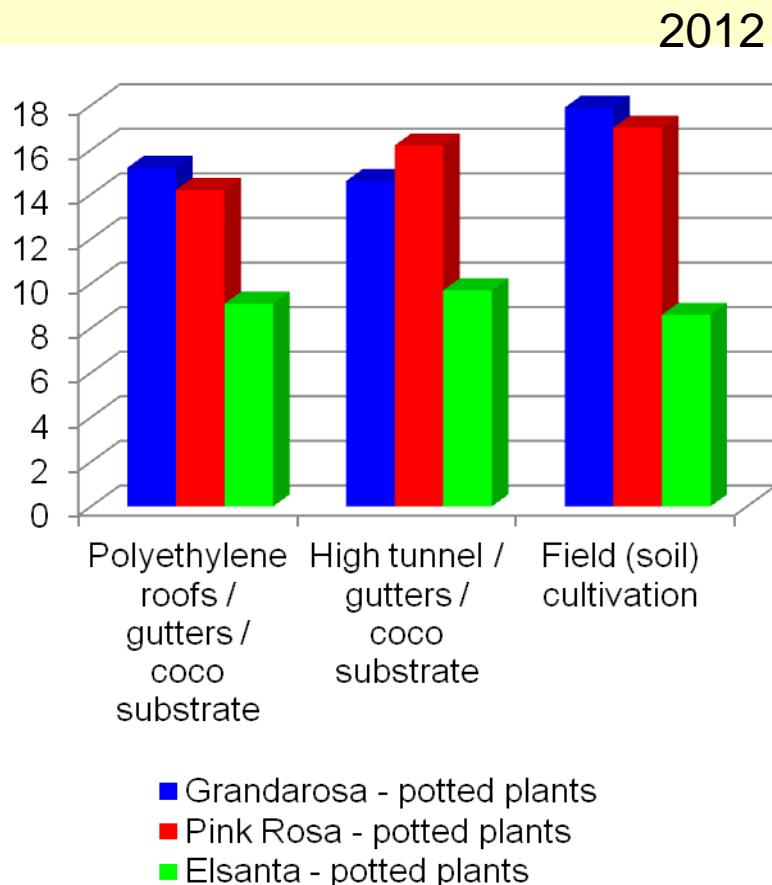


2012: The most productive – plants grown in the field. The lowest yield – Elsanta under roofs and Grandarosa under tunnel. Polish cultivars – more productive than Elsanta

2013: The most productive – Pink Rosa under tunnel, Grandarosa and Elsanta – similar yield. Potted plants of Grandarosa and Pink Rosa more productive than bare root plants under roofs

EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

AVERAGE FRUIT WEIGHT (g)



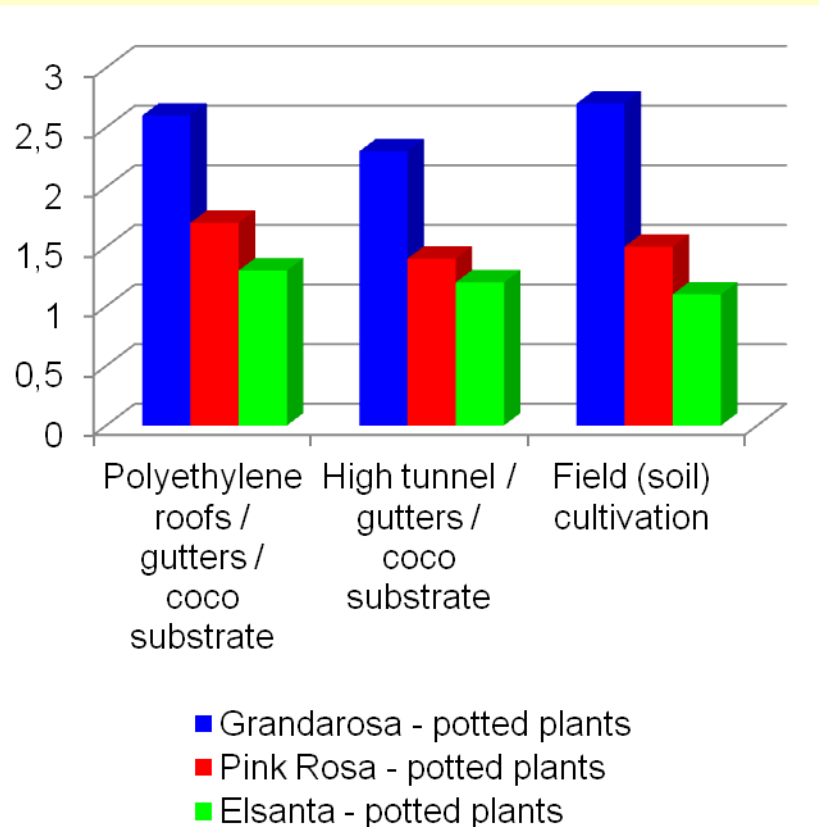
2012: Grandarosa and Pink Rosa had larger fruits than Elsanta. The largest fruits of these cvs – in the field.

2013: The largest fruits – under polyethylene roofs. Both Polish cultivars had larger fruits than Elsanta.

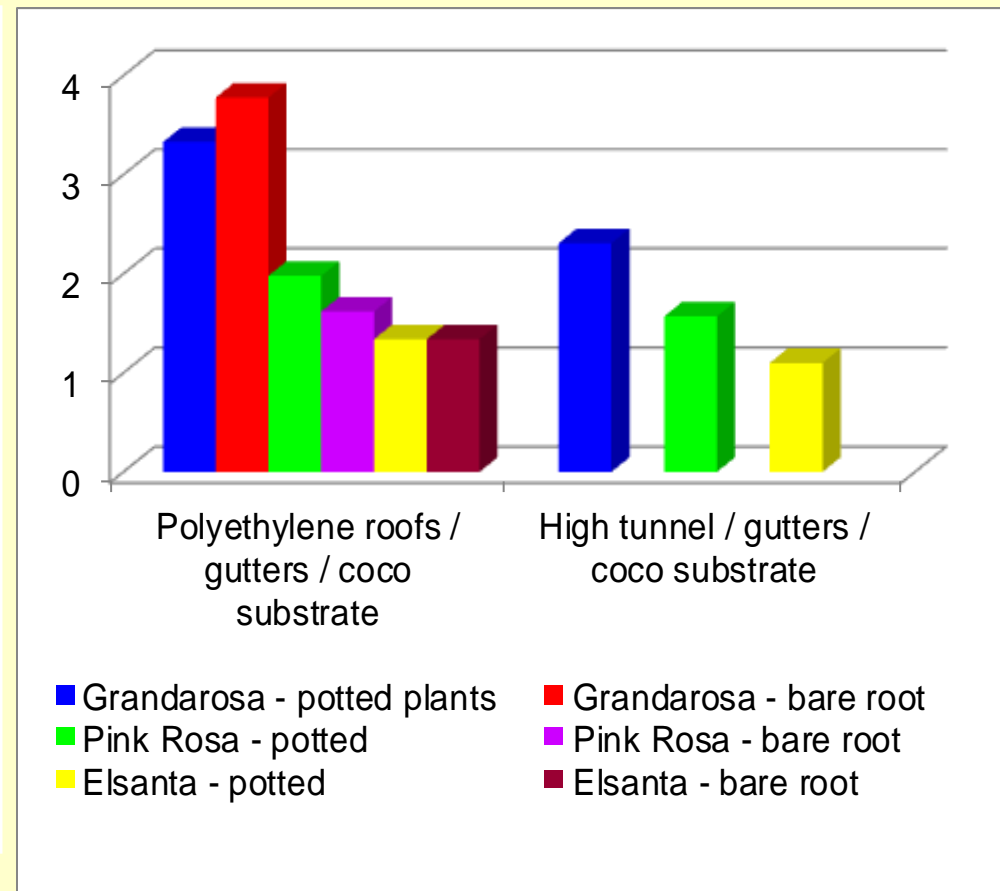
EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

FRUIT FIRMNESS (N)

2012



2013

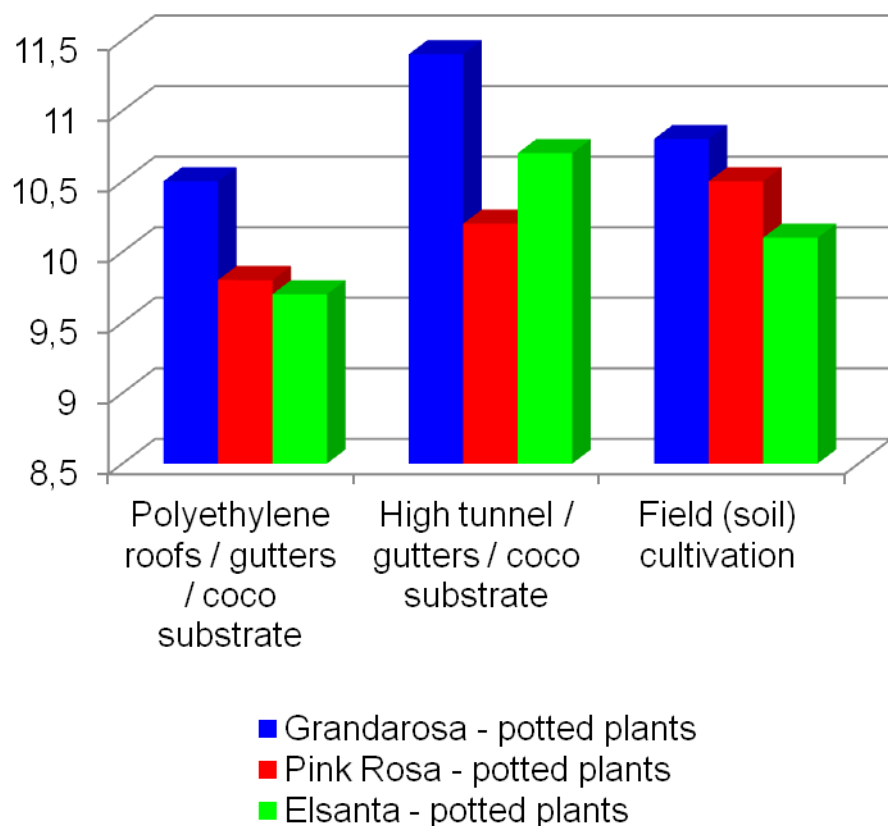


2012: The most firm fruits – Grandarosa in all techniques (the largest – field, the smallest – tunnel). Pink Rosa and Elsanta – the largest fruits under polyethylene roofs.
2013: The largest fruits – under roofs, especially Grandarosa

EXP. II: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS UNDER COVERS

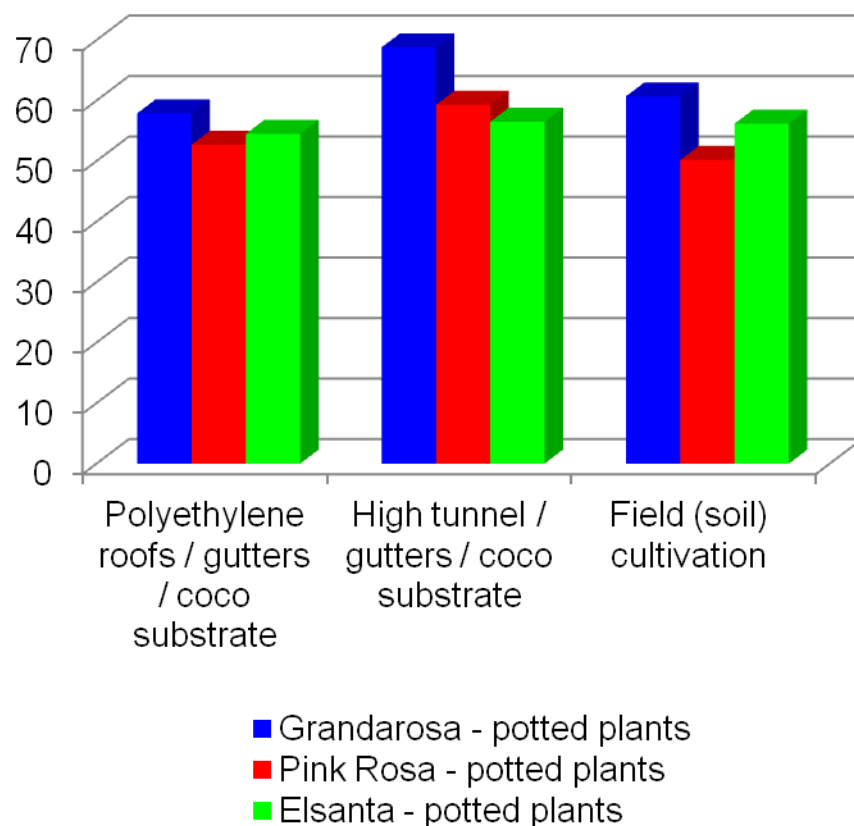
SOLUBLE SOLIDS (°Brix)

2012



ASCORBIC ACID (mg/100g)

2012



2012: Grandarosa fruits – richest in soluble solids and ascorbic acid. The highest soluble solid content – in fruits of Grandarosa and Elsanta under tunnel, while Pink Rosa – in the field
The highest content of ascorbic acid – in fruits of all cultivars under tunnel.

SUMMARY – Experiment II

- Fruits of Elsanta ripened as the first, while fruits of Pink Rosa were the latest one. Fruit picking under the tunnel started 4-5 days earlier, than under polyethylene roofs and in the open field.
- Elsanta was the least productive and had the smallest fruits, regardless of cultivation conditions. The highest yield and the largest fruits were picked from plants of Pink Rosa.
- Grandarosa had the most firm fruits, regardless of the cultivation conditions. Fruits picked under the tunnel were softer than the fruits harvested under polyethylene roofs or in the field.
- Fruits of Grandarosa were the richest in soluble solids and ascorbic acid. The highest content of these components were found in fruits harvested under the tunnel.

EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

PLANT MATERIAL

- 3 cultivars
- Dates of planting:
2012 - 1st June, 15th June and 30th June (Series I);
2013 - 17th June, 1st July and 10th July (Series II)
- Potted and bare root frigo plants

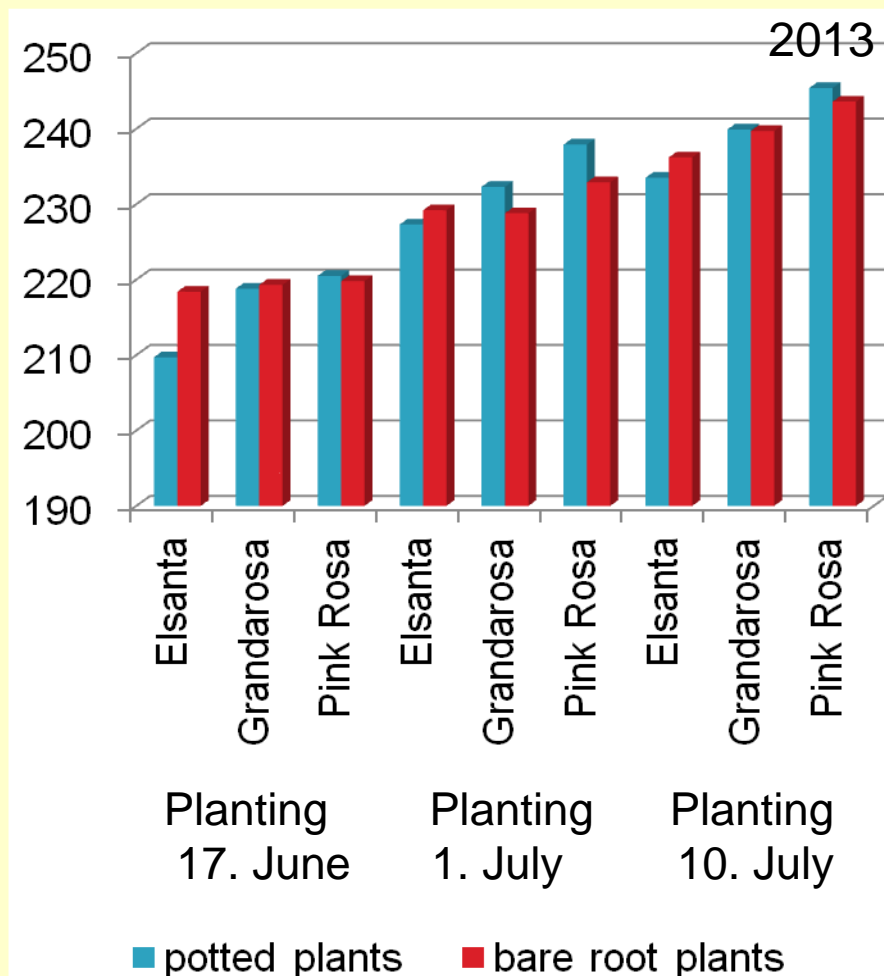
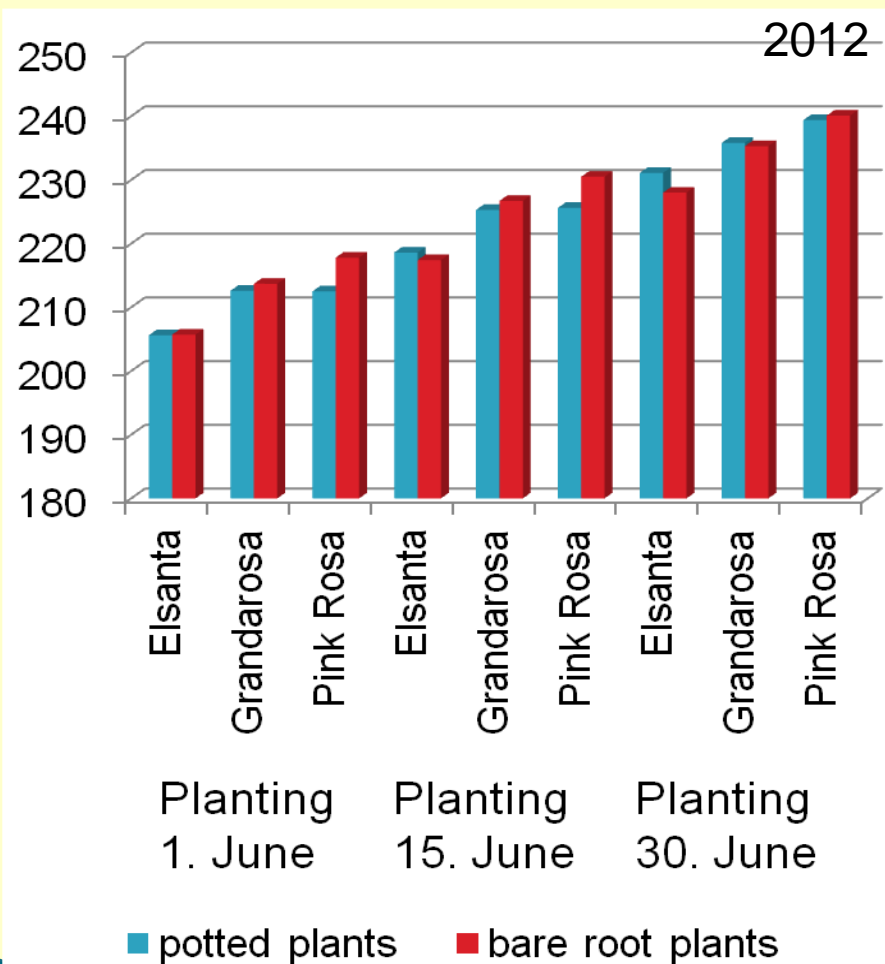


DESIGN OF THE EXPERIMENT

- 15 plants per plot
- 4 replications
- Distance: 1,1 x 0,25 m

EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

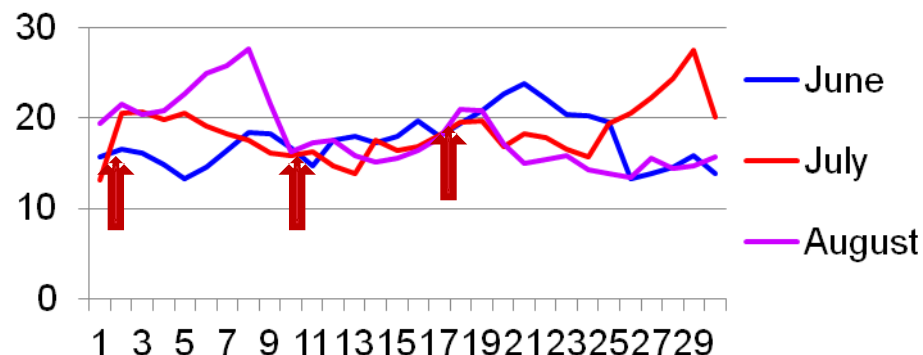
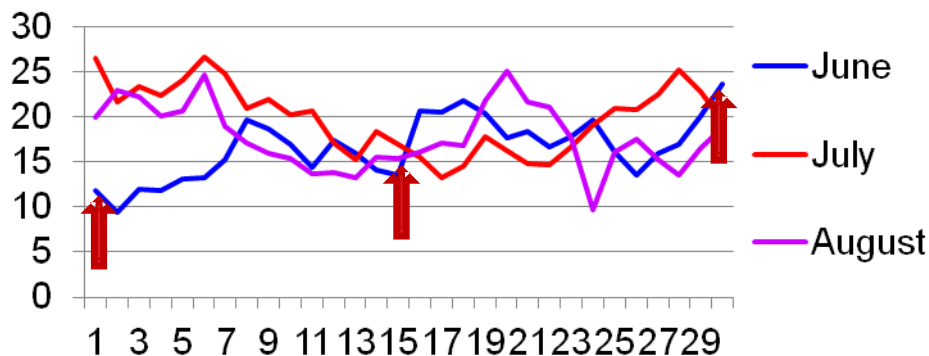
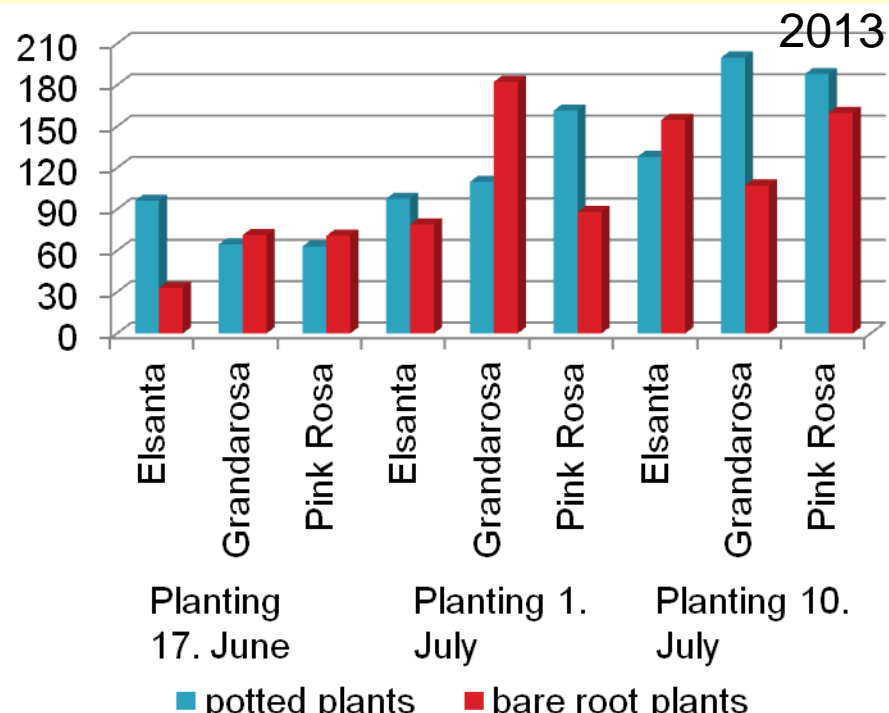
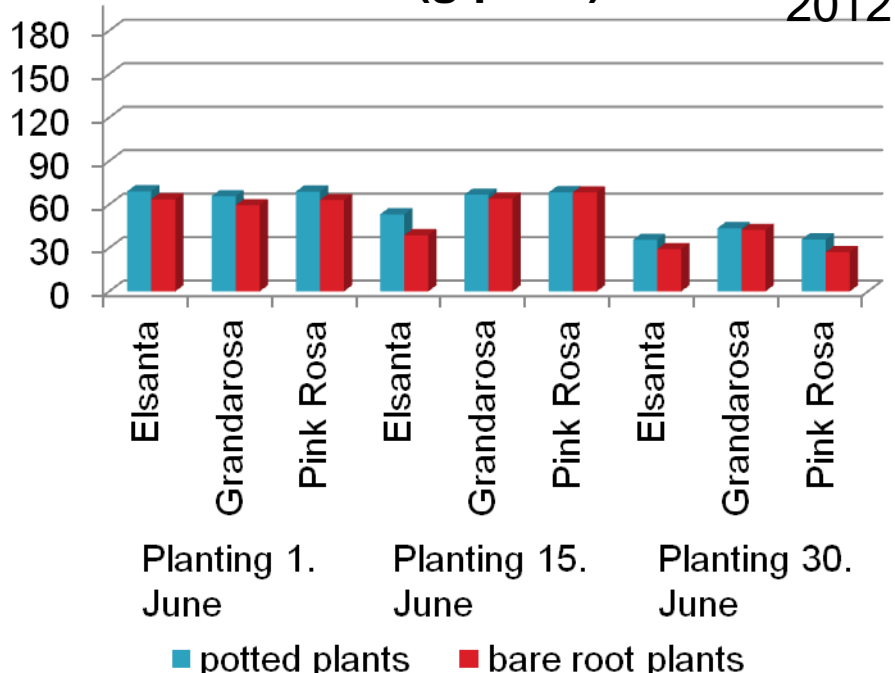
FRUIT RIPENING TIME – FAEDI INDEX



In all the planting combinations Elsanta started ripening about 4-5 days earlier than Grandarosa and 10-12 days earlier than Pink Rosa. Fruits of potted plants ripened a little earlier than from bare root plants.

EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

PRODUCTIVITY (g/plant)

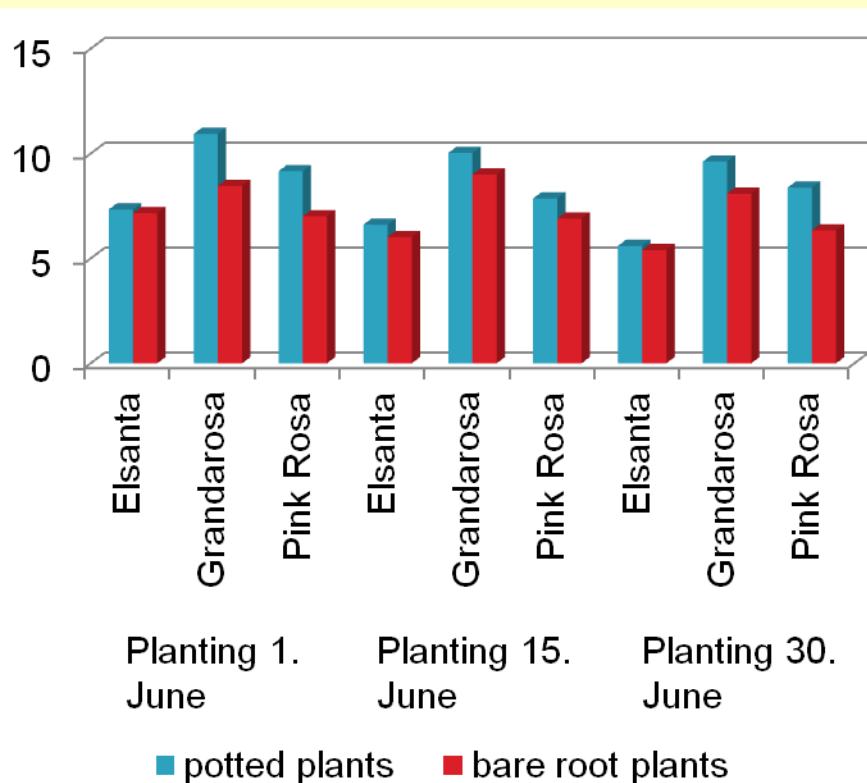


In 2012 the lowest yield obtained from plants planted 30. June, while in 2013 – from plants planted 17. June. Reason – hot temperature just after planting (above 23°C)

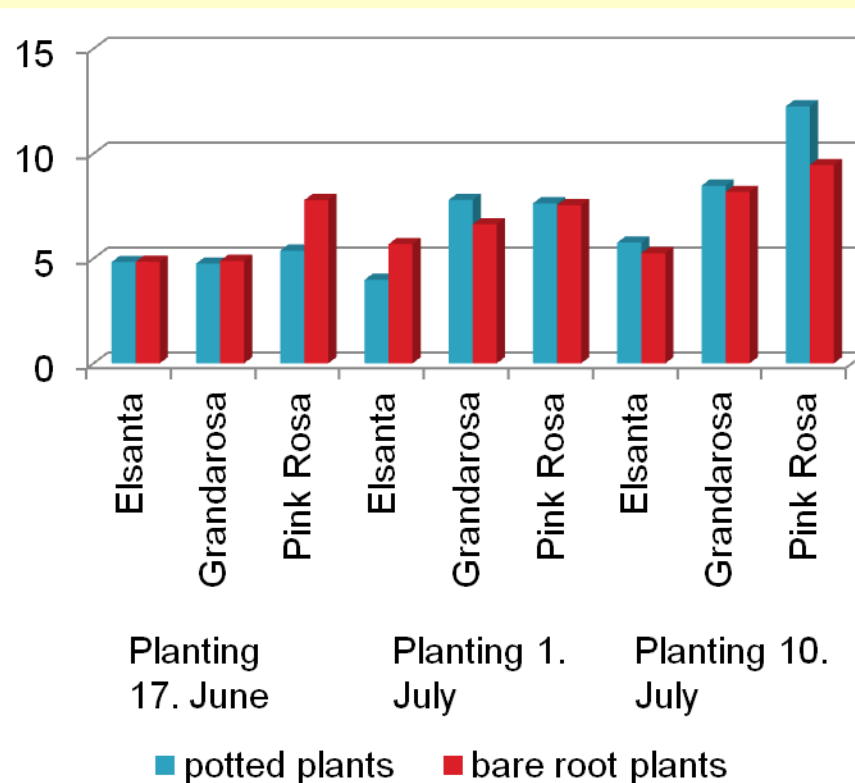
EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

FRUIT SIZE (WEIGHT - g)

2012



2013

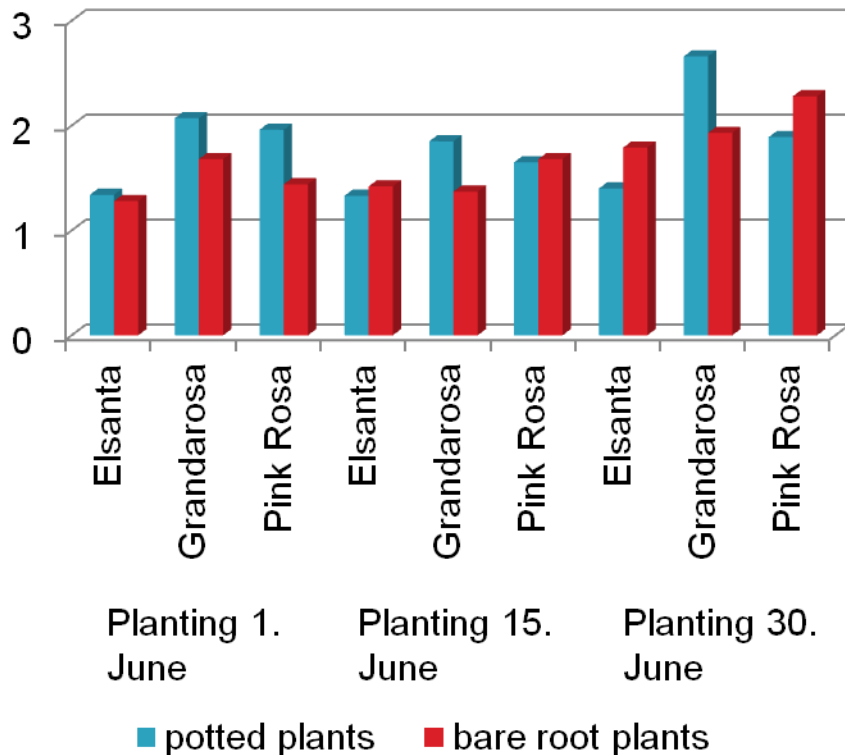


In 2012 the smallest fruits obtained from plants planted 30. June, while in 2013 – from plants planted 17. June. Elsanta had the smallest fruits in both years. The largest fruits – Grandarosa in 2012 and Pink Rosa in 2013. In most of the combinations fruits produced by potted plants were larger than the fruits produced by bare root plants.

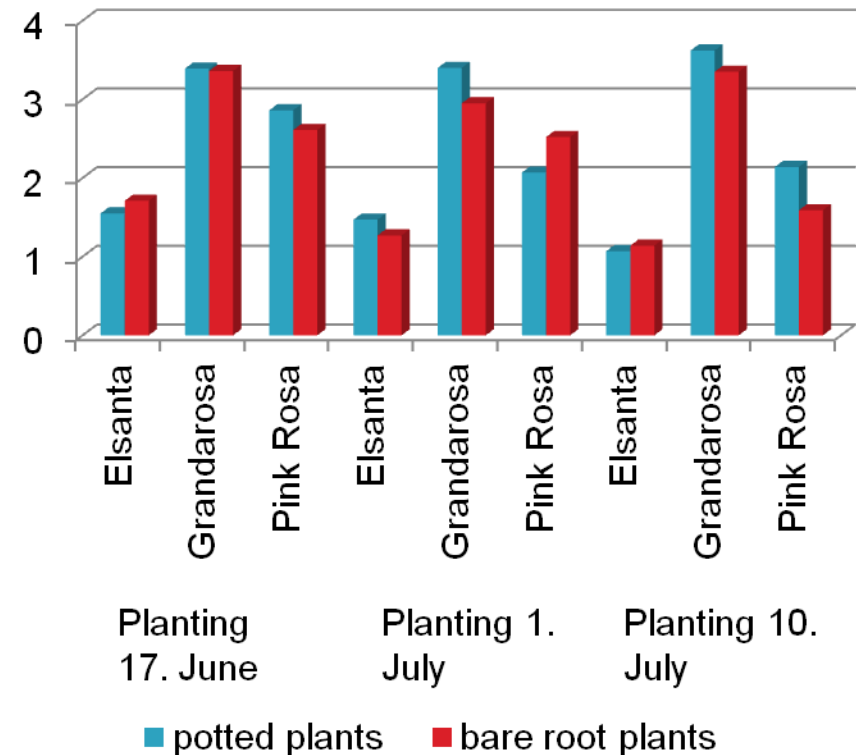
EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

FRUIT FIRMNESS (N)

2012



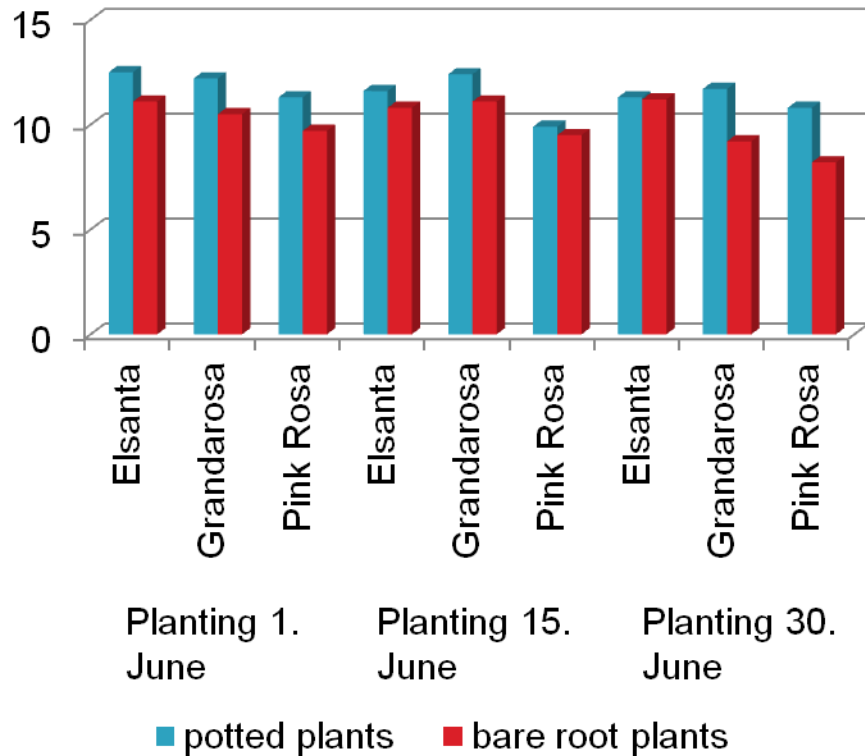
2013



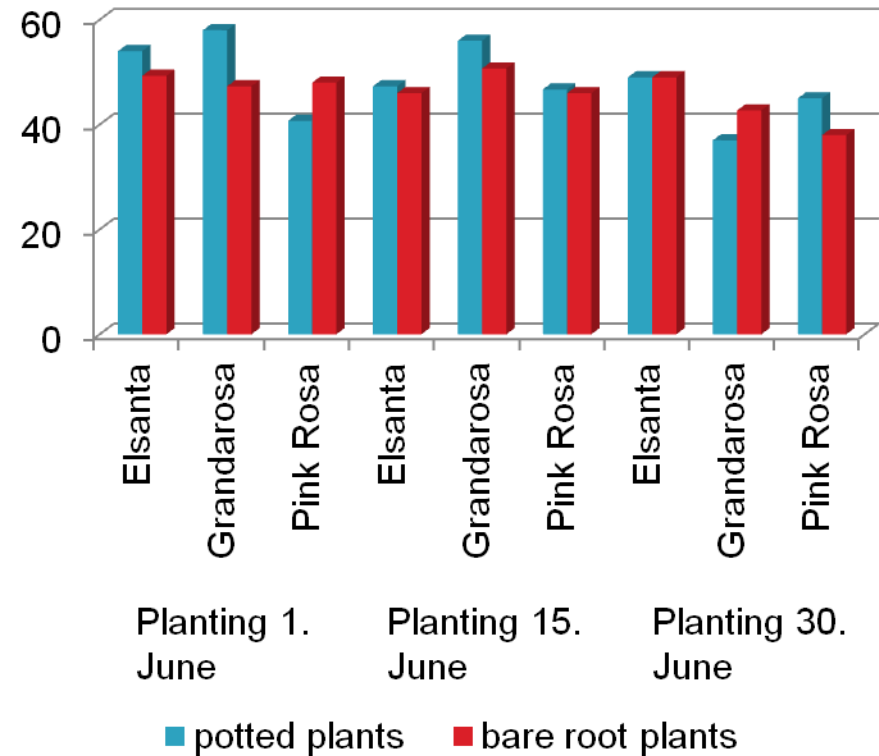
In both years the firmest fruits had Grandarosa, while the softest – Elsanta. In most of the combinations fruits from potted plants were firmer than from bare root plants.

EXP. III: PRODUCTION FOR LATE FRUIT RIPENING BY LATE PLANTING OF FRIGO „A” PLANTS IN THE OPEN FIELD

SOLUBLE SOLID CONTENT



ASCORBIC ACID CONTENT



The content of soluble solid and ascorbic acid in fruits were mainly depended on weather conditions and genotype. In most of the combinations fruits of Grandarosa and Elsanta contained much soluble solids and ascorbic acid than Pink Rosa.

SUMMARY – Experiment III

- Delayed planting of strawberry frigo plants influenced on delaying of fruit ripening time. From the plants planted at the same time, the most early were fruits of Elsanta, while the most late - fruits of Pink Rosa.
- Evaluation of the productivity and fruit quality showed, that the traits were strongly modified by weather conditions after planting of strawberries. In 2012 the lowest yield was obtained from the plants planted at the end of June, while in 2013 – from the plants planted in the middle of June.
- Grandarosa and Pink Rosa had larger fruits than Elsanta, especially in combinations with potted plants.
- Fruits of Grandarosa were the most firm and rich in soluble solids and ascorbic acid in the most of the combination studied.



**THANK YOU
FOR YOUR ATTENTION**

Instytut Ogrodnictwa



InHort
SKIERNIEWICE